BMW & LAND ROVER Importer
For Guam, Marianas &
Micronesia

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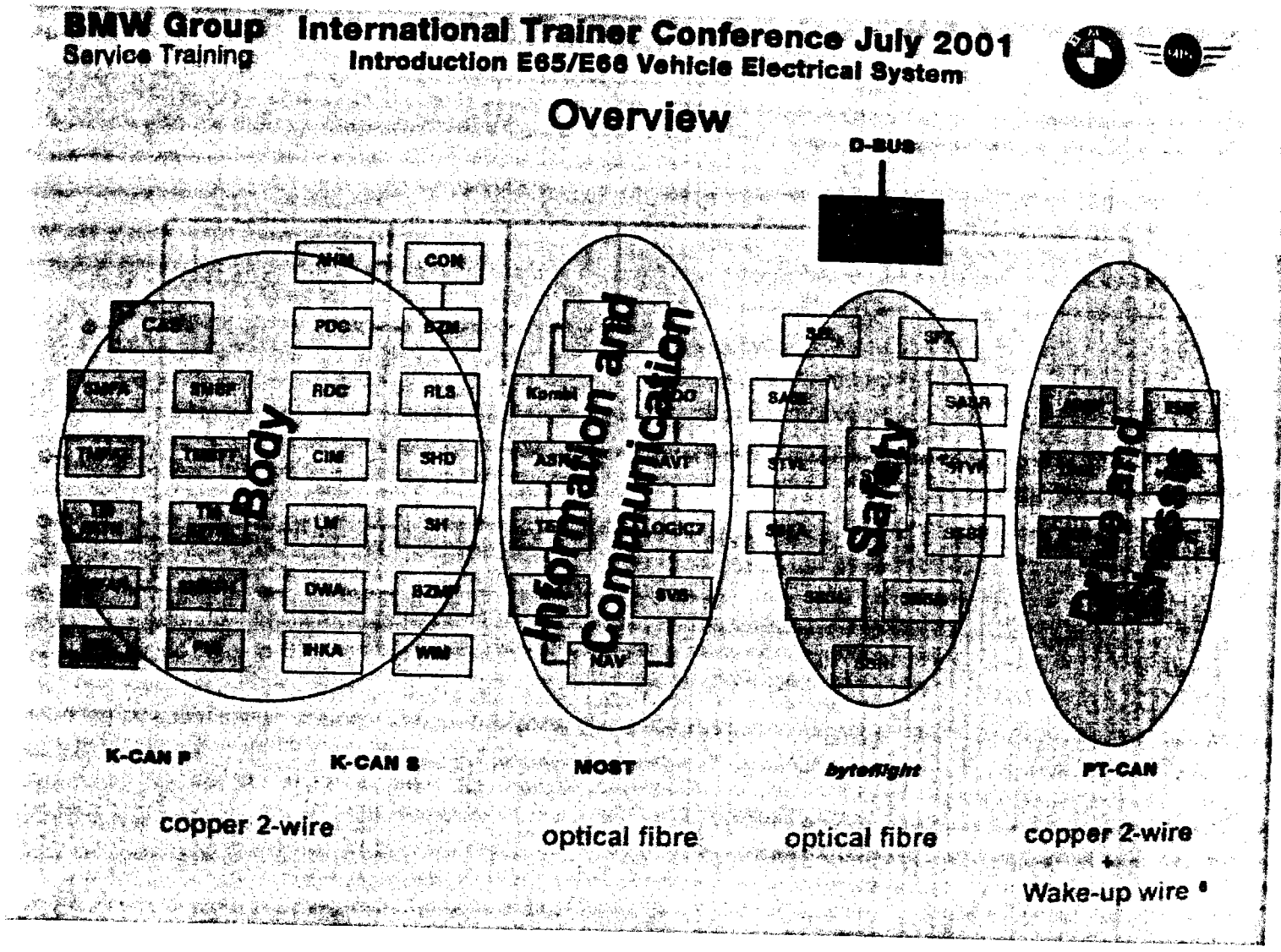
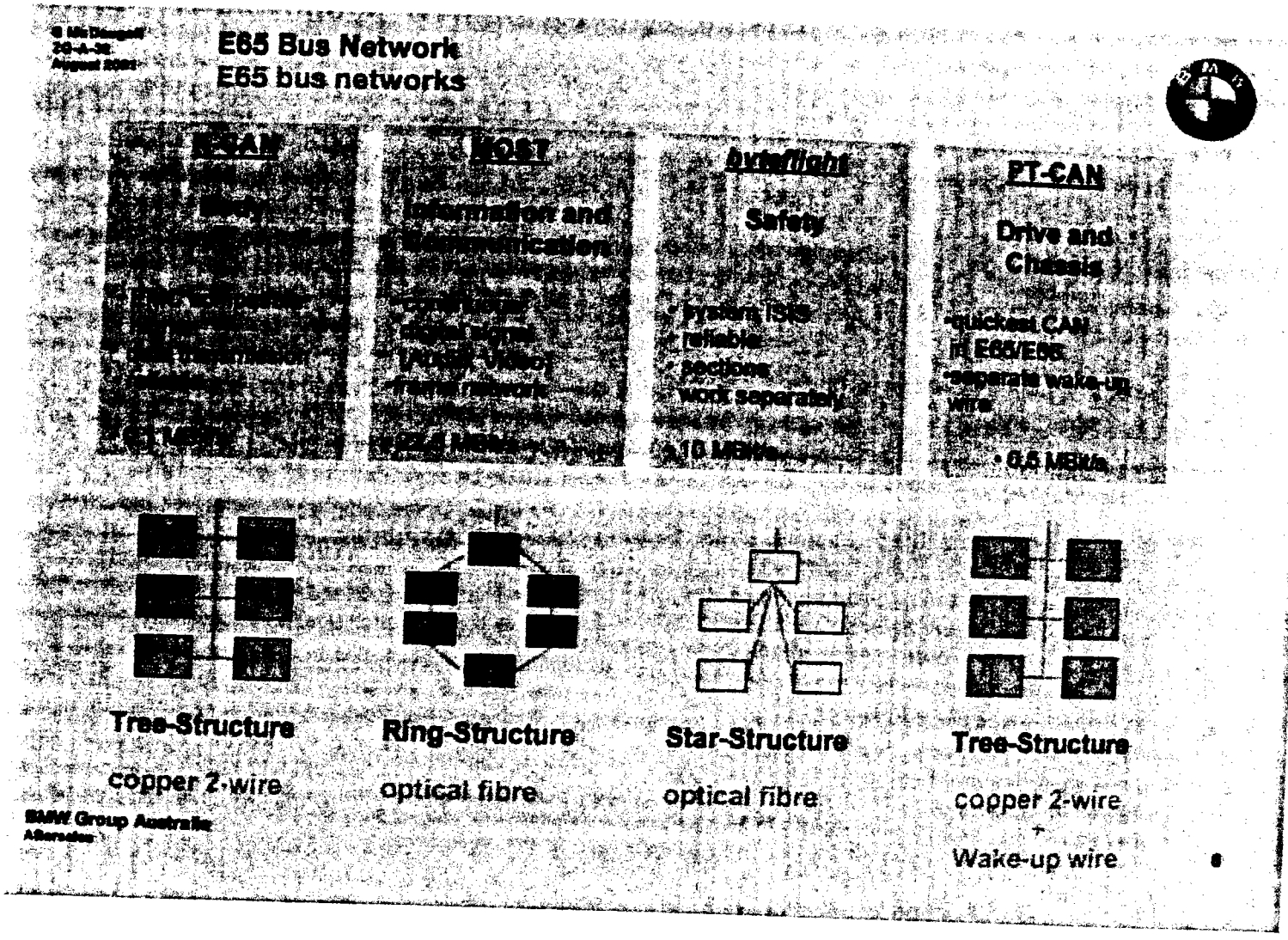
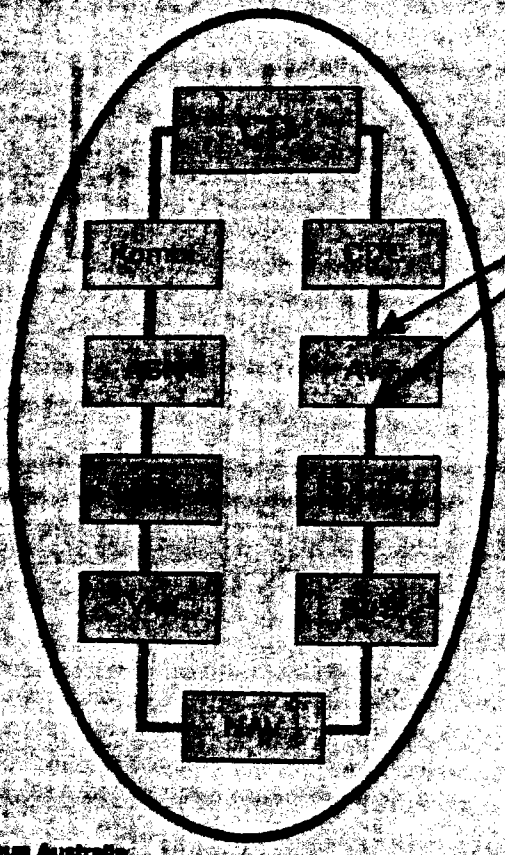

BMW Group
Service Training
International Trainer Conference July 2001
Introduction E65/E66 Vehicle Electrical System
Overview
D-BUS
Body
Communication and Information
Safety
Drive
AHM
CON
PDC
BZM
RDC
RLS
CIM
SHD
LM
SH
DWA
BZMF
IHKA
WMI
NAV
SFK
SAM
SAMR
K-CAN P
K-CAN S
MOST
byteflight
PT-CAN
copper 2-wire
optical fibre
optical fibre
copper 2-wire
+
Wake-up wire

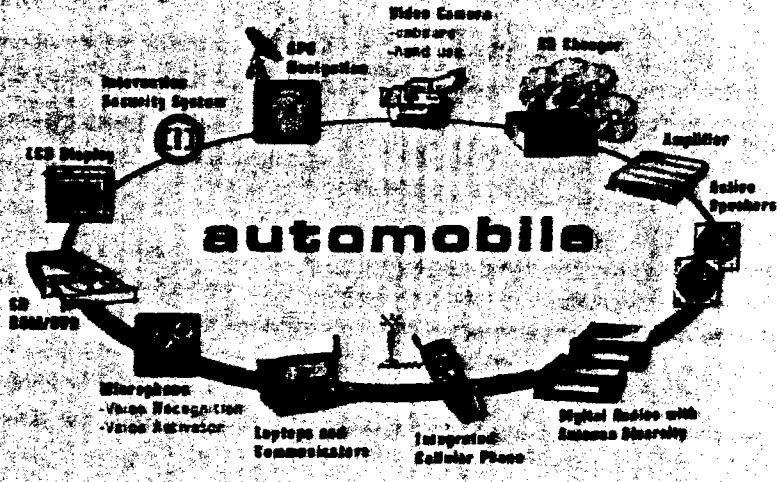

E65 Bus Network
E65 bus networks
K-CAN
Information and
MOST
Information and
Safety
PT-CAN
Drive and
Chassis
Tree-Structure
copper 2-wire
Ring-Structure
optical fibre
Star-Structure
optical fibre
Tree-Structure
copper 2-wire
+
Wake-up wire

E65 Bus Network
Optical fibre technology



MOST

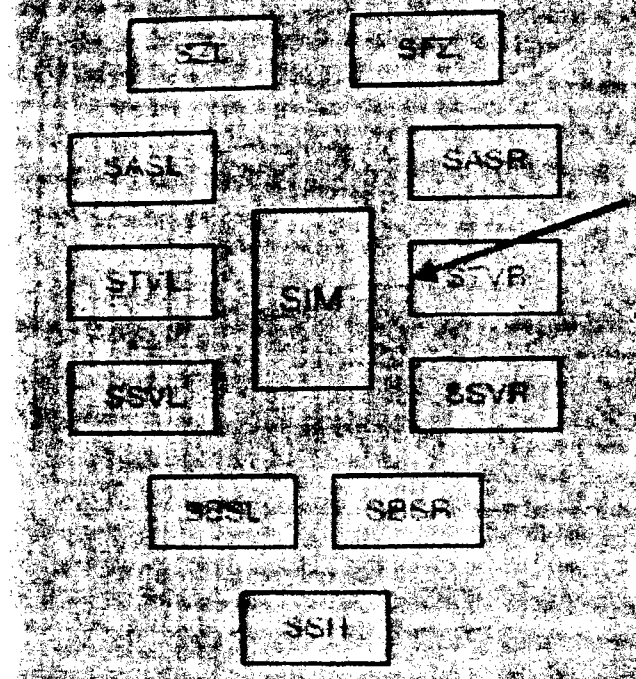
- Ring structure
- Separate sender and receiver
- Large amount of data
- Audio-Data and Video-Data
- Frame network
- Data transmission: 22,5 Mbit/s



BMW Group Australia

10

E65 Bus Network
Optical fibre technology



byteflight

Star structure

Integrated sender and receiver

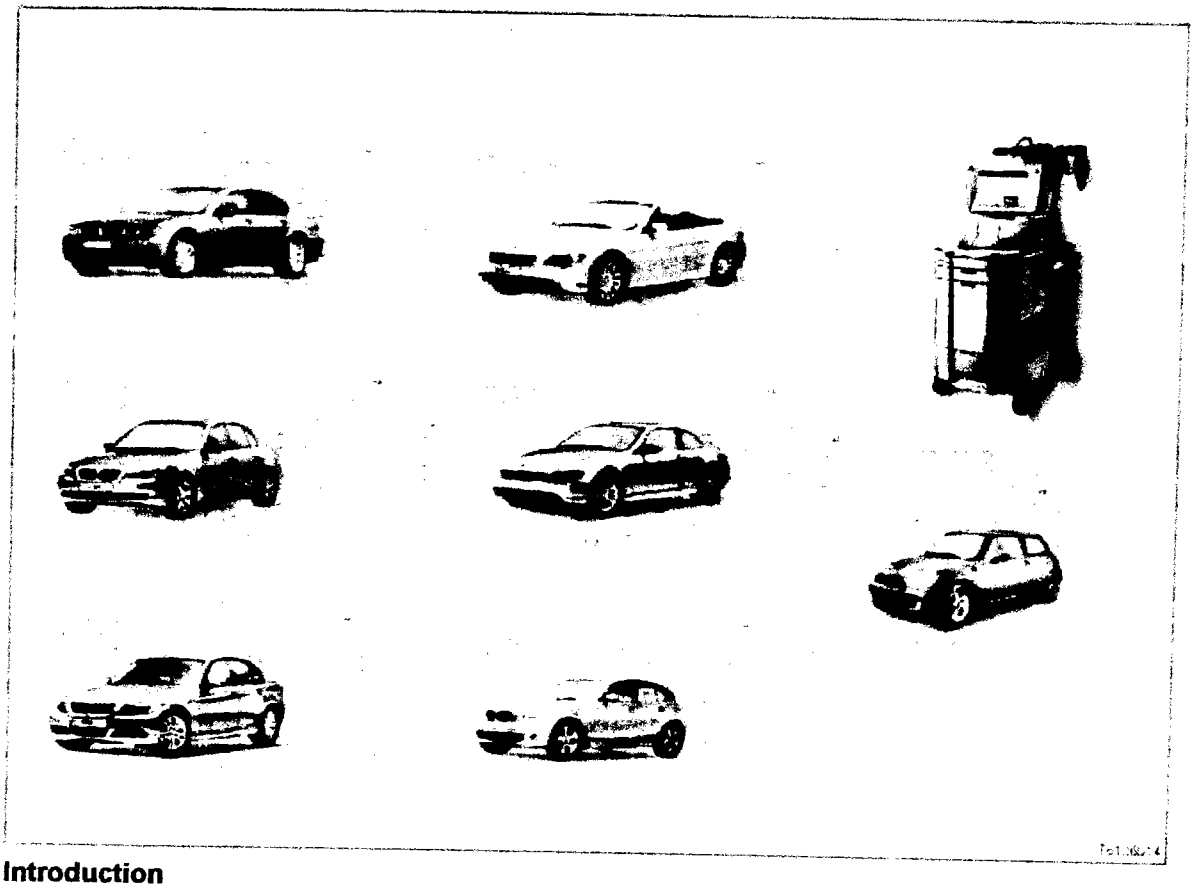
High demand on safety data transmission

Satellites work separately

Data transmission: 10 Mbit/s

Bus diagnosis

All models from E60



Introduction

In the vehicles of today, components and control units are networked by means of data buses. Data buses are capable of transmitting messages with signals.
The connected control units only read off those messages and signals that are of relevance to their operation.

Most buses are CAN buses (CAN: Controller Area Network). There are several CAN buses with different data transmission rates in each car.
For example, the PT-CAN has a fast data transmission rate, the K-CAN a slower data transmission rate.
A fibre-optic cable is used for navigation and entertainment: the MOST bus (MOST = "Media Oriented System Transport")
There is a separate data wire for diagnosis: the diagnosis wire, also known as the "K-wire".
[for more information, please refer to SI Technology (SBT) 61 03 05 144]

The following options are available for locating faults in data buses and in control units:

- **Test module for diagnosis on the CAN buses in the BMW diagnosis system: "Bus system analysis"**

  The test module is called up in the DIS (Diagnosis and Information System) as follows: "Function selection" button -> Complete vehicle -> Body -> Bus functions -> Bus analysis -> System analysis

- **Checking the terminating resistances:**

- **Test module for diagnosis on the MOST buses: "MOST system analysis"**

  The test module is called up in the DIS (Diagnosis and Information System) as follows: "Function selection" button -> Complete vehicle -> Body -> Bus functions -> MOST functions -> MOST system analysis.

These two test modules and the installation points of the terminating resistances are described in detail below.

Bus system analysis

The bus system analysis narrows down the cause of **intermittently** occurring faults in the area of the data buses and control units.

The test results of bus system analysis state the following possible causes of fault:

- Data bus XY defective
- Gateway XY defective (= interface for data exchange)
- Control unit XY defective

Note: Diagnosis of intermittent faults and permanent faults.

All cases where a data bus or control unit only fails **temporarily** (i.e. intermittently) are difficult for diagnosis.

In such cases, the entries in the control units' fault memories do not point unambiguously to an intermittent failure of a particular data bus or control unit.

Intermittent failure of a particular data bus or control unit causes many different fault memory entries in several control units.

If a data bus fails **completely** and **permanently**, the affected control units are no longer available for diagnosis. The fault is thus easy to locate.

Note: Path details for the "bus system analysis" test module

The test module is called up in the DIS (Diagnosis and Information System) as follows:

"Function selection" button -> Complete vehicle -> Body -> Bus functions -> Bus analysis -> System analysis

In order to determine the cause of a system fault in the bus system the following prerequisites have been established:

- If a communication fault occurs in the control units of the bus system, then this communication fault is not shown in the fault memory of the control unit concerned. This also means that no "x" appears before this control unit in the short test.
- The quick-test list contains "real" installed control units and a "virtual" control unit with following names:
  - "CAN/**byteflight** system analysis" on the E65, E66 and on the E60, E61, E63, E64 up to 09/2005
  - "CAN system analysis" on the E87, E90, E91, E92, E93 and R56 and on the E60, E61, E63, E64 from 09/2005

  In this case, "virtual" means that this is not a real control unit but a wild card for all control units on the CAN bus or **byteflight**.
- The short test for this "virtual" control unit reads the communication fault from all control units.
- An "x" in front of this "virtual" control unit indicates that the short test has analysed one of the following faults:
  - No communication with the respective gateway (data interface for all busses):
    > R56

    JBE: Junction box electronics

SGM: Safety and gateway module

> E87 or E90, E91, E92, E93

JBE: Junction box electronics

- Breaks in the wiring in a bus
- Intermittent fault in a control unit

Functions of bus system analysis

Bus system analysis is a test module that automatically executes the following steps:

Step 1: Identification of engine type

Identifying the engine type is a prerequisite for bus system analysis, since different engines generate differen fault code memory entries for the same cause of fault.

Step 2: Read fault memories of all control units

Step 3: Check fault memory entries for undervoltage

If the vehicle has suffered an undervoltage, the undervoltage is the most likely cause of the bus failure. Bus system analysis checks whether a fault memory entry indicating undervoltage is present in at least 2 control units.
If no undervoltage can be detected, continue with step 4.

Step 4: Check how many fault memory entries were found

If at least 1 fault memory entry is present, continue with step 5.

Step 5: Evaluation of fault memory entries and creation of a list of most probable fault causes

Bus system analysis computes the 3 most probable fault causes.

The 3 most probable fault causes are given in a list.

The most probable fault cause is at the top of the list.

Message in the BMW diagnosis system
The fault causes detected are as follows: [1] ** ** Cause of fault PT-CAN [2] ** Cause of fault ZGM [3] * Cause of fault ... [4] End test module The most probable fault cause is given under [1]. Select inspection step.

Note: The number of stars denotes priority.

The stars in front of a cause of fault indicate how probable the cause of fault is. 5 stars denote the most likely cause of fault.
1 star is allocated to a cause of fault that has very low probability.

Step 6: Selection of the test module

Terminating resistors

The installation locations are listed below for the purposes of measuring the terminating resistor values.

> **R56**

- **PT-CAN**
  - 1 resistor is in the SZL control unit in the version with steering angle sensor (SZL: steering column switch cluster)

    1 resistor is in the EPS control unit (EPS: electro-mechanical power steering)
- **F-CAN**
  - Vehicles with Dynamic Stability Control (DSC)

    1 resistor is in the DSC control unit
    1 resistor is in the DSC sensor (under the front-passenger seat)

> **E60, E61, E63, E64**

- **PT-CAN**
  - 1 resistor is in the DSC control unit (DSC: dynamic stability control)
  - 1 resistor is in the SGM control unit (safety and gateway module)

    From 09/2005, this resistor is in the KGM control unit (body-gateway module)
- **F-CAN**
  - Vehicles **with AS** (Active Steering)

    1 resistor is in the cumulative steering-angle sensor in the steering box.

    1 resistor is in the DSC sensor (under the front passenger seat).
  - Vehicles **without AS** (Active Steering)

    1 resistor is in the DSC control unit (DSC: Dynamic Stability Control
    1 resistor is in the DSC sensor 2 (under the front-passenger seat; DSC sensor 1 is under the driver's seat).

> **E65, E66**

- **PT-CAN**
  - 1 resistor is in the wiring harness at the front on the right spring strut dome.
    This resistor can be disconnected from the PT-CAN.
  - 1 resistor is in the wiring harness under the back seat.

    This resistor cannot be disconnected.

> **E87, E90, E91, E92, E93**

- **PT-CAN**

  Different terminating resistors are used depending on the motorisation:
  - Vehicles with engine N4... (basic variant and High equipment)

    1 resistor is in the DSC control unit (DSC: Dynamic Stability Control)

    1 resistor is in the JBE control unit (JBE: junction box electronics)
  - Vehicles with engine M47, M57, N5... (basic variant and High equipment)

    1 resistor is in the DSC control unit (DSC: Dynamic Stability Control)

    1 resistor is in the EKP control unit (EKP: controlled fuel pump)

Different terminating resistors are used depending on the motorisation:

- Vehicles with engine N4... (basic variant and High equipment)

  1 resistor is in the SZL control unit (SZL: steering column switch cluster)

- Vehicles with engine M47, M57, N5... (basic variant and High equipment)

  1 resistor is in the DSC control unit (DSC: Dynamic Stability Control)

  1 resistor is in the SZL control unit (SZL: steering column switch cluster)

MOST system analysis

The MOST bus has a ring structure. This means that a fault in one control unit can have an effect on the entire system. The cause of a system fault (= communication fault) in the MOST network is not readily apparent.

The "MOST system analysis" test module (BMW diagnosis system from DIS CD 36) was developed in order to analyse faults in the communication of MOST control units.
The MOST system analysis has been improved in DIS-CD 38.

Note: Path details for the "MOST system analysis" test module

The test module is called up in the DIS (Diagnosis and Information System) as follows:

"Function selection" button -> Complete vehicle -> Body -> Bus functions -> MOST functions -> MOST system analysis.

In order to determine the cause of a system fault in the MOST network, the following prerequisites have been established:

- If a communication fault occurs in MOST control units, then this communication fault is not shown in the fault memory of the control unit concerned. This also means that no "x" appears before this control unit in the short test.
- In addition to the list of "really" fitted control units in the short test, a "virtual" control unit appears called "MOST system analysis".

  In this case, "virtual" means that this is not a real control unit, but a wild card for all MOST control units.
- The short test for the "MOST system analysis" "virtual" control unit reads the communication faults of all the MOST control units.
- An "x" in front of this "MOST system analysis" "virtual" control unit indicates that the short test has analysed one of the following faults:
  - No communication with the following control units:
    - > R56

      CCC: Car Communication Computer

      RAD2: radio 2 (Radio Boost)
    - > E60, E61, E63, E64

      CCC or M-ASK: car communication computer or multi-audio system controller
    - > E65, E66

      CD: Control Display
    - > E87, E90, E91, E92, E93

      CCC or M-ASK: car communication computer or multi-audio system controller

      RAD2: radio 2 (BMW "Professional" radio)
  - MOST ring break

EXHIBIT C

FUJITSU THE POSSIBILITIES ARE INFINITE

Fujitsu Microelectronics America, Inc.

Fujitsu Introduces Next-Generation FlexRay™ Controller, Enabling X-by-Wire Technology for In-Vehicle Networks

Built around Bosch IP, New MB88121 Supports FlexRay Version 2.0

Sunnyvale, CA, September 13, 2005 — Fujitsu Microelectronics America, Inc. (FMA) today introduced the industry's leading FlexRay™ controller, the MB88121, an application-specific standard product that supports FlexRay version 2.0.

Based on IP developed by Robert Bosch GmbH, the MB88121 delivers 10 Megabit per second over two channels. It provides fault-tolerant, deterministic data transmission, which is suitable for the engine control, braking and steering subsystems now being introduced using the FlexRay protocol.

The MB88121 is designed to complement all of the existing standard automotive buses, including the Controller Area Network (CAN) and Local Interconnect Network (LIN). FlexRay-based technology, which can provide approximately 10 times the throughput of CAN, is expected to gradually replace CAN as automakers and their suppliers adopt x-by-wire solutions in new generations of vehicles.

Fujitsu has been a world leader in FlexRay product development, as a member of the FlexRay Consortium, and as the first company to deliver a complete developers' kit designed to enable early-stage application development.

"This new FlexRay communication controller incorporates all the features and capabilities required to spur significant production of FlexRay systems by vehicle makers and automotive-equipment manufacturers," said Keith Horn, senior vice president of sales and marketing for Fujitsu Microelectronics America. "Embedding FlexRay IP into real silicon will allow early adapters to design a range of automotive electronic-control applications at production grade."

The MB88121 can be connected directly to existing CPUs, enabling the development of production systems that use a next-generation network, while simultaneously maximizing the performance of equipment already in the vehicle. Internal speeds reach 80MHz, with a 4, 5, 8, 10MHz external oscillator, or by external clock. The chip's parallel interface affords a maximum frequency of 33MHz.

About the FlexRay Standard

FlexRay is a high-speed serial communication system using point-to-point links over unshielded or shielded twisted pair cable. It features fault tolerance and provides deterministic data transmission at a baud rate of between 500kbps to 10Mbps with a 24-bit CRC. FlexRay is a time-triggered bus, enabling electronic systems to communicate continually in pre-defined time slots.

Fujitsu will maintain its strong commitment to the FlexRay technology by continuing to develop FlexRay enabled components. In 2006, the company plans to begin sampling a new microcontroller with the FlexRay IP built around Fujitsu's FR microprocessor core.

Pricing and Availability

The MB88121 is available now in production quantities with prices beginning under $5 each. It is packaged in an LQFP-64. Fujitsu is now planning a 48-pin version for future release.

Note to editors:
Click here to download the Fujitsu FlexRay ASSP product fact sheet
Click here to download JPEG file of the Fujitsu FlexRay ASSP product photo #1

About Fujitsu Microelectronics America, Inc.

Fujitsu Microelectronics America, Inc. (FMA) leads the industry in innovation. FMA provides high-quality, reliable semiconductor products and services for the networking, communications, automotive, security and other markets throughout North and South America. For product information, visit the company web site at http://us.fujitsu.com/micro/mcu.

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FUJITSU THE POSSIBILITIES ARE INFINITE

Fujitsu Microelectronics Asia Pte Ltd

Fujitsu Introduces Controller-Area-Network (CAN) Microcontroller for Automotive Applications

Singapore, 8 July 2004 — Fujitsu Microelectronics Asia Pte Ltd, one of the major players in the Microelectronics and Flat Panel Display Industry today announced the launch of 16bit Microcontroller series with built-in CAN micro, at the Thailand Electronics and Industrial Technology Exhibition 2004.

Fujitsu has been responding to the ever changing demands for the automotive engineering network with leading edge technologies. Automotive is one of the many focuses that Fujitsu has excelled in. Since Fujitsu had first introduced Microcontrollers with built-in CAN macro in the mid 1990s, Fujitsu has been expanding its 16bit Microcontroller series and has now some of the most extensive range of Microcontrollers with CAN Macro built-in. For the high-end automotive application, Fujitsu has also a range of specialized 32bit Microcontrollers which are feature-rich, low-power, high-performance and cost-effective.

Since the introduction of CAN in the automotive industries, CAN is now one of the most widely accepted network within the vehicles. Over the years, industries such as Factory Automation and Healthcare have also adopted this type of network for the reason that CAN has sophisticated functions to support error detection. It is very reliable, robust in communication, has simplified two-wire communication and uses differential voltage of two-wire to reduce noise. CAN specially stands out in the automotive application as the two-wire communication means reduction in cost for the network within the vehicle, lighter in weight (lesser wirings), much more simplified wire-harness design and equipment used within the vehicle.

The Fujitsu CAN Controller is a full CAN Macro that supports 'CAN Version 2.0B Active'. It means that it can support Identifier of up to 29bit instead of the normal 11bit of a Basic CAN. The Fujitsu CAN also has multiple-message buffer of up to 16 transmitting messages. With the 16bit Microcontroller, it comes with enhanced features such as low-power consumption mode, stepper motor controller, input-capture units, output-compare unit and many timers to support the different applications.

Some of the series suitable for different applications

Dashboard :	MB90390 series MB90420 series MB90540 series MB90590 series
Gateways :	MB90495 series MB90540 series MB90590 series
Power Seats :	MB90385 series MB90495 series MB90590 series MB91360 series
Car Infotainment System :	MB90390 series
HVAC system :	MB90440 series MB90540 series
Power Window :	MB90385 series MB90495 series
Steering Wheel :	MB90385 series MB90495 series
Instrumental Cluster :	MB90390 series MB90440 series

	MB90540 series MB90440 series MB91302 series MB91360 series

About Fujitsu Microelectronics Asia Pte Ltd

Fujitsu Microelectronics Asia Pte Ltd was established as the Asia –Pacific Headquarters of Fujitsu Limited Electronic Devices Group in 1986. It provides support, sales and marketing of Microelectronics and Flat Panel Display products to the Asia Pacific region, including India and Oceania.
Fujitsu Microelectronics Asia offers a wide and varied product range like ASIC, ASSPs, Flat Panels (LCD / PDP), Microcontrollers / Microprocessors (FR-V), System Memory (Flash Memory / FRAM / FCRAM) and System LSIs (DVD MPEG Source Decoders / MPEG –2 Encoders)

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